

WHAT IS CLAIMED IS:

1 1. A fuel cartridge that supplies a source of fuel to a direct methanol fuel cell, the
2 fuel cartridge comprising:

3 a housing;
4 a fuel egress to allow contents in the housing to escape from the housing; and
5 a surface area enhanced planar vaporization membrane residing in the fuel cartridge.

1 2. The fuel cartridge of claim 1 wherein the surface area enhanced planar
2 vaporization membrane is a polymer membrane disposed about a substantial portion of an
3 interior of the housing to provide a high surface area membrane.

1 3. The fuel cartridge of claim 1 wherein the surface area enhanced planar
2 vaporization membrane is a composite membrane comprised of multiple layers or folds of
3 polymer membrane to increase vapor permeation surface area.

1 4. The fuel cartridge of claim 1 wherein the surface area enhanced planar
2 vaporization membrane is a membrane arranged as a series of folds.

1 5. The fuel cartridge of claim 1 wherein the surface area enhanced planar
2 vaporization membrane is a polymer membrane provided with macroscopically irregular
3 and/or microscopically roughened membrane surfaces to increase the effective membrane
4 surface area for vaporization.

1 6. The fuel cartridge of claim 1 wherein the surface area enhanced planar
2 vaporization membrane spaces a liquid source of oxidizable fuel from a vapor phase of the
3 source of oxidizable fuel.

1 7. The fuel cartridge of claim 1 wherein the cartridge contains a liquid source of
2 oxidizable fuel and/or a carbonaceous compound or mixture of such compounds.

1 8. The fuel cartridge of claim 1 wherein the liquid source of oxidizable fuel is
2 methanol.

1 9. The fuel cartridge of claim 1 wherein the enhanced planar vaporization
2 membrane is comprised of a polymer material selected from the group consisting of
3 polyurethanes, silicones, poly(trimethylsilyl-propyne), polymeric compositions, and
4 composites.

1 10. The fuel cartridge of claim 1 wherein the surface area enhanced planar
2 vaporization membrane enhances a delivery rate of methanol in a vapor phase to the egress
3 port for a given cartridge size.

1 11. A fuel cartridge that supplies a source of fuel to a direct methanol fuel cell, the
2 fuel cartridge comprising:

3 a housing;
4 a fuel egress port supported by the housing; and
5 a composite membrane residing in the fuel cartridge comprising:
6 a porous substrate;
7 a polymer membrane disposed over a first surface of the porous substrate; and
8 a coating of a methanol-impermeable material disposed over an opposite
9 surface of the substrate.

1 12. The fuel cartridge of claim 11 wherein substrate is provided to hold methanol
2 in a liquid state within the porous material to enable liquid methanol to migrate to the
3 polymer membrane and convert to a vapor phase.

1 13. The fuel cartridge of claim 11 wherein the composite membrane is wound into
2 a cylindrical shaped element.

1 14. The fuel cartridge of claim 11 wherein gaps between the polymer membrane
2 and the methanol-impermeable coating providing a path for transporting a high flux of
3 methanol vapor to the egress port.

1 15. The fuel cartridge of claim 11 wherein a plurality of the composite
2 membranes are disposed in the fuel cartridge.

1 16. The fuel cartridge of claim 11 wherein a plurality of the composite
2 membranes are disposed in the fuel cartridge and wound into a cylindrical shaped element.

1 17. The fuel cartridge of claim 11 wherein the substrate is polyethylene,
2 polypropylene, nylon, polyurethane, or other analogous polymers or composites of one or
3 more of these polymers.

1 18. The fuel cartridge of claim 11 wherein the polymer membrane is a
2 polyurethane material.

1 19. The fuel cartridge of claim 18 wherein the polymer material is selected from
2 the group consisting of polyurethanes, silicones, poly(trimethylsilyl-propyne), polymeric
3 compositions, and composites.

1 20. The fuel cartridge of claim 18 wherein the polymer has a microporosity
2 characteristic to govern vaporization.

1 21. The fuel cartridge of claim 11 wherein the membrane is a sintered metal disc
2 coated with a polymer.

1 22. The fuel cartridge of claim 11 wherein the methanol-impermeable coating is a
2 cross-linked rubber, a polymer/inorganic composite, a surface fluorinated high density
3 polyethylene, or other methanol-impermeable material.

1 23. The fuel cartridge of claim 11 wherein the substrate is polyethylene,
2 polypropylene, nylon, polyurethane, or other analogous polymers or composites of one or
3 more of these polymers; the polymer membrane is polyurethanes, silicones,
4 poly(trimethylsilyl-propyne), or composites of polyurethanes, silicones, poly(trimethylsilyl-
5 propyne) and the methanol-impermeable coating is a cross-linked rubber, a

6 polymer/inorganic composite, a surface treated material such as surface fluorinated high
7 density polyethylene, or other methanol-impermeable material.

1 24. A composite membrane residing in the fuel cartridge comprising:
2 a porous substrate;
3 a polymer membrane disposed over a first surface of the porous substrate; and
4 a coating of a methanol-impermeable material disposed over an opposite
5 surface of the substrate.

1 25. The membrane of claim 24 wherein substrate is provided to hold methanol in
2 a liquid state within the porous material to enable liquid methanol to migrate to the polymer
3 membrane and convert to a vapor phase.

1 26. The membrane of claim 24 wherein the composite membrane is wound into a
2 cylindrical shaped element.

1 27. The membrane of claim 24 wherein gaps between the polymer membrane and
2 the methanol-impermeable coating providing a path for transporting a high flux of methanol
3 vapor.

1 28. The membrane of claim 24 wherein the substrate is polyethylene,
2 polypropylene, nylon, polyurethane, or other analogous polymers or composites of one or
3 more of these polymers.

1 29. The membrane of claim 24 wherein the polymer material is selected from the
2 group consisting of polyurethanes, silicones, poly(trimethylsilyl-propyne), polymeric
3 compositions, and composites.

1 30. The membrane of claim 24 wherein the polymer has a microporosity
2 characteristic to govern vaporization.

1 31. The membrane of claim 24 wherein the membrane is a sintered metal disc,
2 coated with a polymer.

1 32. The membrane of claim 24 wherein the methanol-impermeable coating is a
2 cross-linked rubber, a polymer/inorganic composite, a surface fluorinated high density
3 polyethylene, or other methanol-impermeable material.

1 33. The membrane of claim 24 wherein the substrate is polyethylene,
2 polypropylene, nylon, polyurethane, or other analogous polymers or composites of one or
3 more of these polymers; the polymer membrane is polyurethanes, silicones,
4 poly(trimethylsilyl-propyne), or composites of polyurethanes, silicones, poly(trimethylsilyl-
5 propyne) and the methanol-impermeable coating is a cross-linked rubber, a
6 polymer/inorganic composite, a surface treated fluorinated high density polyethylene.

1 34. An arrangement comprises:
2 a direct methanol fuel cell;
3 a fuel cartridge that supplies a source of fuel to the direct methanol fuel cell, the fuel
4 cartridge comprising:
5 a housing;
6 a fuel egress port supported by the housing; and
7 a surface area enhanced planar vaporization membrane residing in the fuel cartridge
8 and
9 a fuel reservoir that receives fuel from the fuel cartridge, the fuel reservoir arranged
10 to deliver fuel to the fuel cell and the fuel reservoir comprising:
11 a housing; and
12 a surface area enhanced planar vaporization membrane residing in the fuel reservoir,
13 which in combination with the surface area enhanced planar vaporization membrane residing
14 in the fuel cartridge provides a dual stage vaporization of fuel to the fuel cell.

1 35. The arrangement of claim 34 wherein at least one of the surface area enhanced
2 planar vaporization membranes is a polymer membrane disposed about a substantial portion
3 of an interior perimeter of the housing to provide a high surface area membrane.

1 36. The arrangement of claim 34 wherein at least one of the surface area enhanced
2 planar vaporization membranes is a composite membrane comprised of multiple layers or
3 folds of polymer membrane to increase vapor permeation surface area.

1 37. The arrangement of claim 34 wherein at least one of the surface area enhanced
2 planar vaporization membranes is a membrane arranged as a series of folds.

1 38. The arrangement of claim 34 wherein at least one of the surface area enhanced
2 planar vaporization membranes is a polymer membrane provided with macroscopically
3 irregular and/or microscopically roughened membrane surfaces to increase the effective
4 membrane surface area for vaporization.

1 39. A method of operating an electronic device comprises:
2 arranging a fuel cartridge to supply a source of fuel to a direct methanol fuel cell, the
3 fuel cartridge comprising:
4 a housing;
5 a fuel egress port supported by the housing; and
6 a composite membrane residing in the fuel cartridge comprising:
7 a porous substrate;
8 a polymer membrane disposed over a first surface of the porous substrate; and
9 a coating of a methanol-impermeable material disposed over an opposite
10 surface of the substrate.